UNIVERSITY OF MARYLAND

Department of Physics

University of Maryland — M. Laurenzi
Physics 161
12-01-05 — Name______________________________
Exam III
Chapters 8,9 and 10

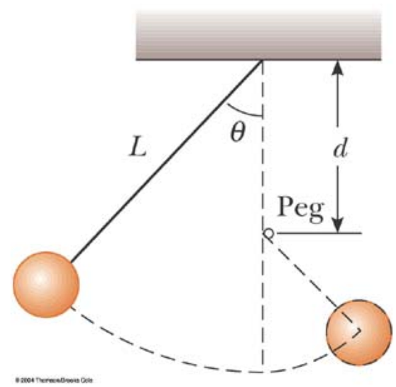
Each question is worth a total of 100 pts. The points will be distributed evenly by dividing 100 by the number of sub-questions. The grade you receive will be a percent grade. *For problems which involve numbers use only one significant figure.* For all the problems, your answers will be evaluated in part on how you arrived at them. Little or no credit will be given for answers that do not show how you got them. Partial credit will be considered when the steps to the answer are correct, even if the final solution is wrong. More partial credit will be given for clear, neat logical attempts at solutions and less to those that are hard to understand.

Solve the following problems completely for full credit. **Please do your work under the problem on the exam page NEATLY.** Please do not write on backs of pages. **Please make a box around your final answer.** The test is closed books, notes and classmates. Do the questions that you find less challenging first. Then follow up with those that seem to be more difficult. Best of Luck…..

There is a seating chart attached. Seat yourself in a seat that has a dark square in it.

At the end of the exam, write and sign the honor pledge in the space below: "I pledge to my honor that I have not given nor received any unauthorized assistance on this examination."

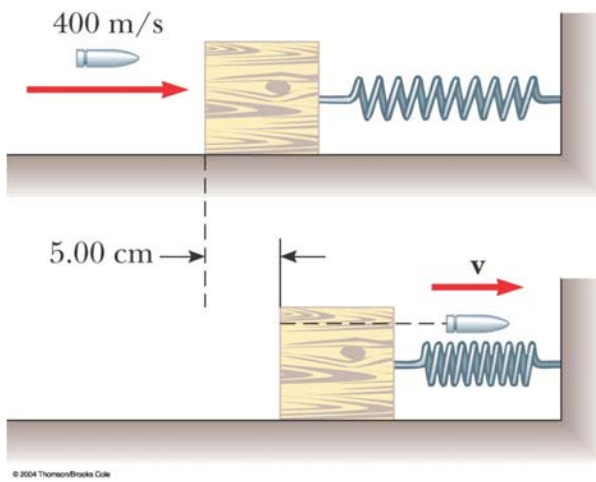
1. A pendulum, comprising a string of length L and a small sphere, swings in the vertical plane. The string hits a peg located a distance d below the point of suspension.



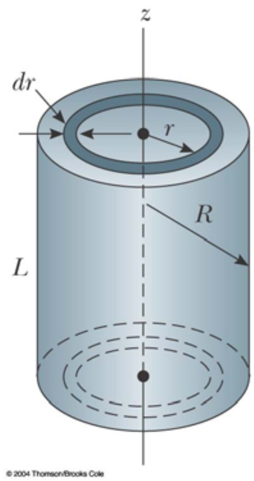
a) If the pendulum is released from $\theta = 90°$, the length of the string L is equal to 5/3m and in the course of its motion, the mass swings in a complete circle around the peg. What is the minimum value for d?

2. A 5.0g bullet moving with an initial velocity of 400m/s is shot into and passes through a 1.0kg block that is attached to spring. The other side of the spring is attached to a wall as seen in the diagram. The wooden block is initially at rest on a frictionless, horizontal surface with spring possessing a spring constant of 900N/m. At maximum compression of the spring the block has moved 5cm to the right. After the bullet has left the block: (the bullet does not stay in the block)

a) Find the velocity of the bullet when it emerges from the block.
b) Also, find the mechanical energy converted into frictional energy loss as a result of the collision.

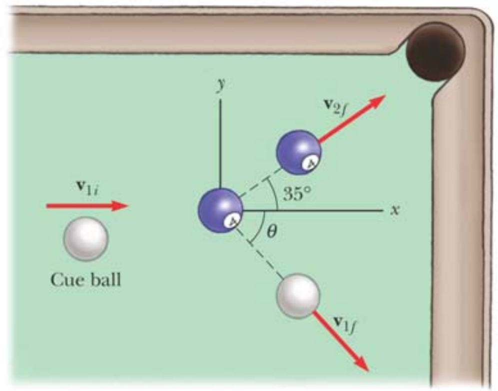


3. Find the total moment of inertia for a cylindrical **shell.**



Keep in mind this a cylindrical shell with a middle section and two ends at the top and bottom. You need to include the contributions from the top and bottom pieces in your answer. Also, assume that the amount of mass distributed on the body of the cylinder, the top of the cylinder and the bottom of the cylinder are each M. So, the body has mass M, the top has mass M and the bottom has mass M.

4. During a game of billiards, a player wishes to sink a target ball in the corner pocket, as shown below. If the angle to the corner pocket is 35°, at what angle θ is the cue ball deflected? Assume that friction and rotational motion can be neglected and the collision is elastic. Also assume that all billiard balls have the same mass m.



Possibly useful information

$\Delta x \equiv x_f - x_i$ $\qquad$ $\Delta t \equiv t_f - t_i$ $\qquad$ $\Delta v_x \equiv v_{xf} - v_{xi}$

$\bar{v}_x \equiv \Delta x / \Delta t$ $\qquad$ $\bar{a}_x \equiv \Delta v_x / \Delta t$ $\qquad$ *av. speed = total dist./time*

$v_x = dx/dt$ $\qquad$ $a_x = dv_x/dt$ $\qquad$ $v_{xf} = v_{xi} + a_x t$

$x_f = x_i + \frac{1}{2}(v_{xi} + v_{xf})t$ $\qquad$ $x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$

$$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$$

$x = r\cos(\theta)$ $\qquad$ $y = r\sin(\theta)$ $\qquad$ $r = \sqrt{x^2 + y^2}$

$a_c = v_t^2 / r$

$\vec{A} \bullet \vec{B} = A_x B_x + A_y B_y + A_z B_z$ $\qquad$ $W = \int \vec{F} \bullet d\vec{r}$

$U_g = mgy$ $\qquad$ $U_s \equiv \frac{1}{2}kx^2$ $\qquad$ $W_g = -(U_f - U_i)$

$\vec{p} = m\vec{v}$ $\qquad$ $\vec{I} \equiv \int_{t_i}^{t_f} \vec{F} dt$ $\qquad$ $\vec{I} = \Delta\vec{p} = m\vec{v}_f - m\vec{v}_i$

$v_{1i} - v_{2i} = -(v_{1f} - v_{2f})$ $\qquad$ $\vec{r}_{cm} = \frac{1}{M}\sum_i m_i \vec{r}_i$ $\qquad$ $\vec{r}_{cm} = \frac{1}{M}\int \vec{r}\, dm$

$\theta = s/r$ $\qquad$ $\omega = d\theta/dt$ $\qquad$ $\alpha = d\omega/dt$

$\omega_f = \omega_i + \alpha t$ $\qquad$ $\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$

$$\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$$

$v_t = r\omega$ $\qquad$ $a_t = r\alpha$ $\qquad$ $a_c = v_t^2 / r = r\omega^2$

$\theta_f = \theta_i + \frac{1}{2}(\omega_i + \omega_f)t$ $\qquad$ $I = \int r^2 dm$ $\qquad$ $K = \frac{1}{2}I\omega^2$